

# A review on Stegnography in QR Codes

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**Abstract** – Stegnography is the method of hiding a message, video, file or image within another message, video, file or image. To enhance the security of private messages QR codes are used. QR (Quick response) codes are a type of 2 dimensional bar code with which we can interact with the internet through a smart phone. This paper does a survey on various methods to hide private messages within a QR code

**Key Words:** Quick Response code, Steganography, Discrete Wavelet Transform.

## INTRODUCTION

With the emergence in internet technologies the need for data hiding increased. The users across internet needs to send and receive private data. And this private data should be protected from unauthorised attacks. Stegnography is the method of hiding private information under a cover. The cover may be a video, image, or an audio. The private information inside a QR code is embedded in a cover image and send to the receiver. At the receiver end a decoding algorithm is used to extract the private information from the cover image. QR code can embed information both in vertical and horizontal direction so that it can encode more information. QR codes are used because of it's high error correction capability. Error correction in QR code is based on Reed-Salomon Codes. QR codes are also easy to create and deploy. QR codes are capable of storing large amount of information and can be read from any direction. There are various methods proposed to embed private information inside a cover image.

### 1.1 Stegnography

The word stegnography meaning "covered writing" is originated in Greece. In stegnography no one else is aware of the hidden data other than the sender and the intended receiver. The difference between cryptography and stegnography is that cryptography conceals the content of a message by encryption whereas stegnography conceals the existence of a message. By combining cryptography and stegnography extra security can be provided to the private data. One of the most popular stenographic method is least significant bit technique which is known as LSB. This method alter few bits in a byte of an image. The change in few bits of data will bring only a small change in the image which cannot be detected by a human eye.

### 1.2 QR code

QR code or Quick Response code was developed by Denso Wave in 1994. QR code is a two dimensional barcode in a matrix form. QR code can store more information than 1 dimensional barcode as it encode information in both vertical and horizontal direction. QR Code are also capable of encoding different characters like alphanumeric and binary characters, Kanji, Kana, Hiragana, symbols, and control codes. QR code can hold large amount of data- 7,089 characters for numeric data, 4,296 characters for alphanumeric data and 2,953 bytes of binary data. QR code contains an array of square modules inside an overall square structure. The main regions inside a QR code are function pattern region, encoding region and the quiet zone. The finder pattern and alignment pattern present in the function pattern region helps in position, size and inclination of the QR code. The encoding region delimited by finder pattern stores data, parity modules and decoding information. The quiet zone is a guard region located outside the QR code. QR code have high error correction capability. The following Table-1 shows the error correction levels of QR code.

**Table -1:** Error correction level of QR code

Error correction level	Error tolerance level
Low(L)	7%
Medium(M)	15%
Quartile(Q)	25%
High(H)	30%

The information present in the QR code is not in human readable format. QR code can be read by a smart phone or a tablet having a camera. QR code reader software is needed to decode the data present in it.

## 2. RELATED WORKS

M. Ramesh et al., [1] proposed an image stegnography method based on frequency domain processing. The cover image and the secret images are read. QR code is generated from the secret image and DWT is applied on the cover image. Hear Wavelet transformation is used. Then fusion process is done both on the DWT cover image and QR coded secret image. The cover image is reconstructed by applying Inverse Discrete Wavelet Transform and a Stego image is obtained which is send across the network. For decoding the secret message the reverse process is used. At the receiver side both the original cover image and the Stego image are read. Then

DWT is applied on both these images. Stego image DWT component is subtracted with original image DWT component and QR code image is obtained. With the help of a QR code reader extract the secret message from the QR code. The performance of this method is measured by quality parameters like Mean Square Error, Peak Signal to Noise Ratio and Normalized Cross Correlation. Normalized Cross Correlation value which measures the similarity between cover image and watermarked image is between 0.96 to 0.99. That shows a high correlation between these two images. The PSNR value showed little distortion on small attacks which indicates the robustness of the system.

M. Mary Shanthi Rani et al., [2] proposed a steganography method in QR codes based on least significant bit. In this method the QR code is created from the secret message with the help of a QR code generator. LSB substitution method is used to embed the quantised QR code in a color image chosen. A Stego image is generated which is transferred across the network. At the receiver side the quantised bits of the QR code is extracted from the Stego image. These bits are dequantised to obtain the QR code. From this with the help of a QR code scanner read the secret message. The performance of this method is measured by quality parameters. PSNR value is almost equal to 52.6 for different message size which indicates a high degree of closeness between the original and Stego image. The bit error rate is also very low which means only a few bits are affected by the embedding process. This method ensures security and integrity to the private message

Hazim Noman Abed [3] proposed a method for steganography based on bat algorithm and LSB. The secret message is XOR-ed with QR code to get encrypted message. The cover image is chosen and bat algorithm is applied on it. The bat algorithm finds the best hiding place to store the secret message. The encrypted message is then embedded in a cover image by LSB method to get the stego image. At the receiver side to extract the secret message bat algorithm is applied. The encrypted message is extracted using LSB method. This will obtain encrypted message and cover image. Encrypted message is again XORed with QR code to get the secret message. The Quality parameters like MSE, PSNR and NC are measured for different size of the cover image and text file. The PSNR showed a high value of around 75 which indicates a high correlation between stego and original image. The NCC value is close to 1 indicating good performance with regards to invisibility and robustness.

Shweta Sharma et al., [4] proposed a steganography method for multiple secret images based on 3-Discrete wavelet transform (DWT) and RSA algorithm. In this method the secret message and four random numbers are read for RSA algorithm. Then the cover image and secret images are splitted into RGB plane. First secret image is hidden in the red component of the cover image. Second secret image is hidden in the green component and third one is hidden in the blue component of the cover image. The secret message is encrypted using RSA algorithm and it is embedded to the cover image using Least significant bit (LSB). The PSNR value and Structural Similarity matrix (SSIM) of a cover image and secret images are calculated. The PSNR value is around 84 and SSIM value is close to 1 which indicates the robustness of the method to attacks. Since this method uses RSA algorithm

and 3-DWT it's performance analysis indicates that it outcomes DWT based algorithm.

Ashwini Warang et al., [5] proposed a method for image steganography using Block based Discrete Wavelet transform and encryption using Advanced Encryption standard. According to their work first the secret data with in a QR code is read. To enhance security the secret data is encrypted using AES algorithm. The cover image undergoes Haar DWT transform. QR code embedding inside the cover image is performed in LSB bit plane. RMSE and PSNR values are calculated for different payloads and different size of cover images. The PSNR value is found to be high when used with QR codes having higher capacity

Athanasios Zigomitos et al., [6] proposed a method to store metadata of a video inside QR code. They implemented it by embedding 3 QR codes in each frame of the video, one in every color domain. Using LSB method the bits of color image are changed to create the QR image in binary form having the metadata. To read the metadata back from the video the modulo 2 of every component is computed which is a binary table. This table when read by a QR reader will return the metadata to the user. One disadvantage of this method is that, it will slightly distort the frame on embedding QR image. The advantage is that even though the video format is changed metadata will remain. The metadata will also be there even though the video is splitted and merged

V. Ramya et al., [7] proposed a method to hide secret text message inside a QR code. First the QR code and secret message are converted to binary form. After obtaining the number of transformations and angle of rotation the secret message is embedded in the QR code. Then rotate the secret data in QR plane. The authors concluded that there is no notable distortion in the stego image with different secret messages

Suppat Rungraungsilp et al., [8] compared data hiding method using DFT and DWT domain for QR Code. For comparison error correcting level L of QR codes is used. In DFT method the QR code is broken into different frequency bands by block DFT and for DWT used Haar wavelet transform. The NCC and PSNR value are calculated. The NCC and PSNR value of DWT based data hiding is far better than DFT based data hiding. The authors also suggested to combine DFT technique with other technique like DWT and DWT technique with techniques like single value decomposition (SVD) method

Pei-Yu Lin et al., [9] proposed a method to store a secret data inside a QR code having high payload. A normal scanner will only obtain formal data while an authorized scanner will obtain the sensitive information from the QR Code. Steganography scheme for QR tag had a secret embedding procedure and extracting procedure. For a QR image and secret message the proposed method will embed the secret message into data codeword and retain the remaining unmodified area. In secret extracting process, the authorized person extract the sensitive information with secret key. The advantage of this method is that it can hide the secrets into a tiny QR tag

### 3. CONCLUSIONS

There are so many methods available to hide private information encoded QR codes. This paper reviewed most of these techniques. Almost every methods showcased satisfactory performance parameters. It is found that Steganography when coupled with encryption algorithms like AES, RSA produced better results. These also provide high end data security to the private data. The widespread use of mobile phones and tablet made the various stenographic methods in QR code more practical and convenient.

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